(No Model.)

J. E. GREENAWALT.

OXIDIZING FURNACE.

No. 551,725. Patented Dec. 17, 1895.

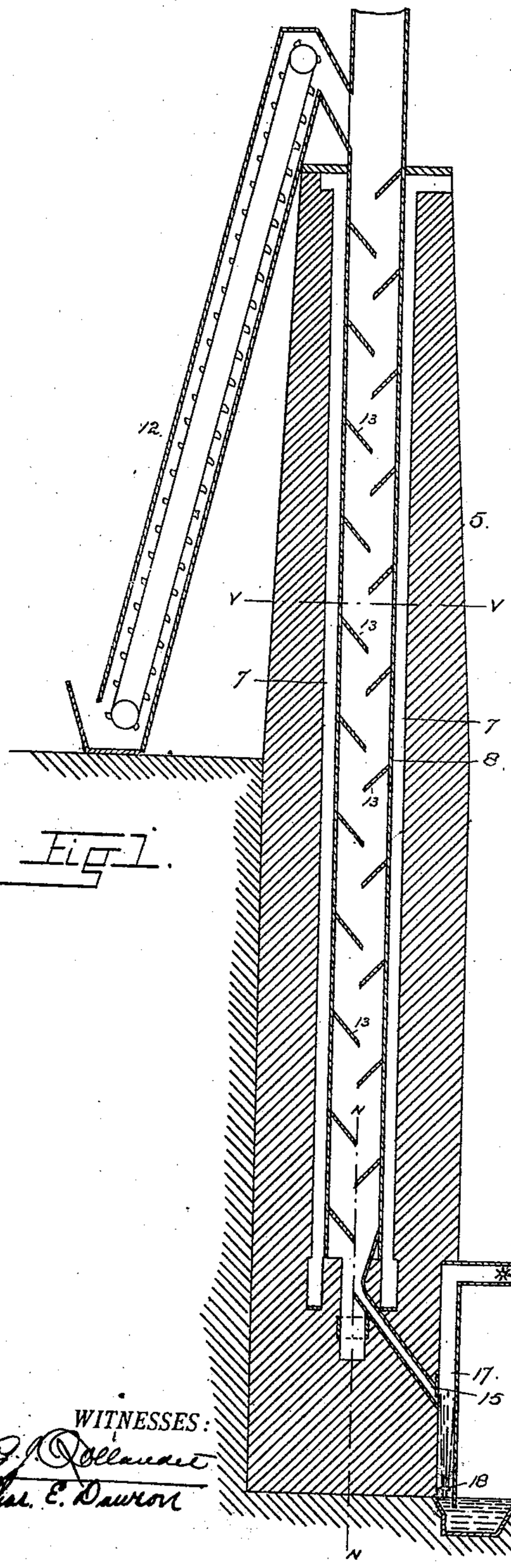

Fig. 1.

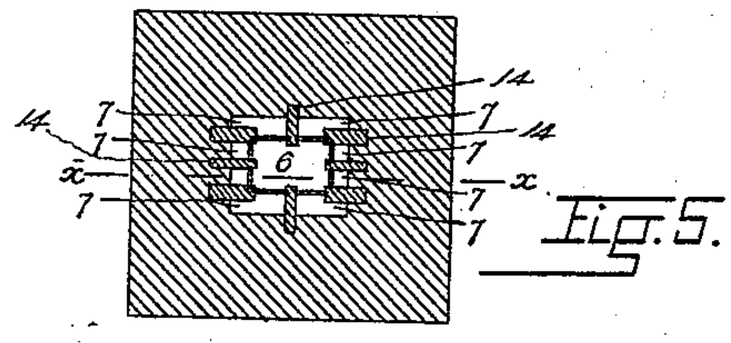

Fig. 5.

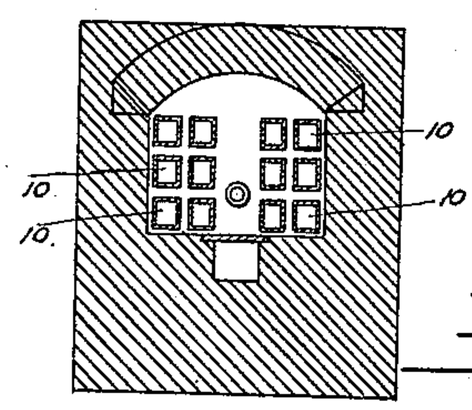

Fig. 4.

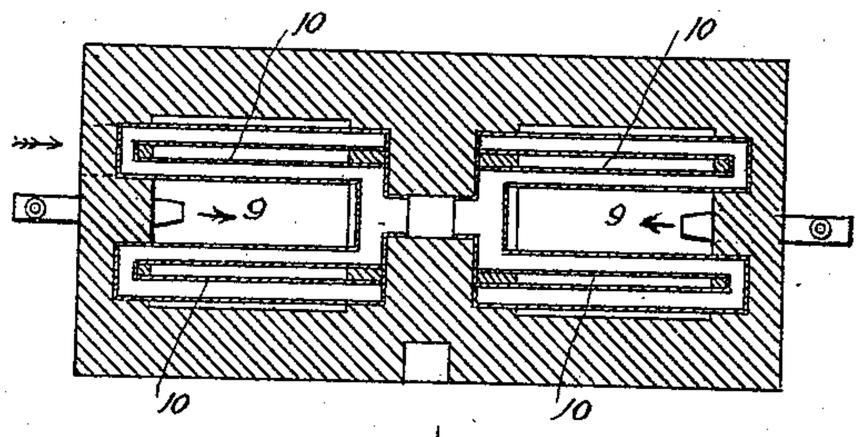

Fig. 3.

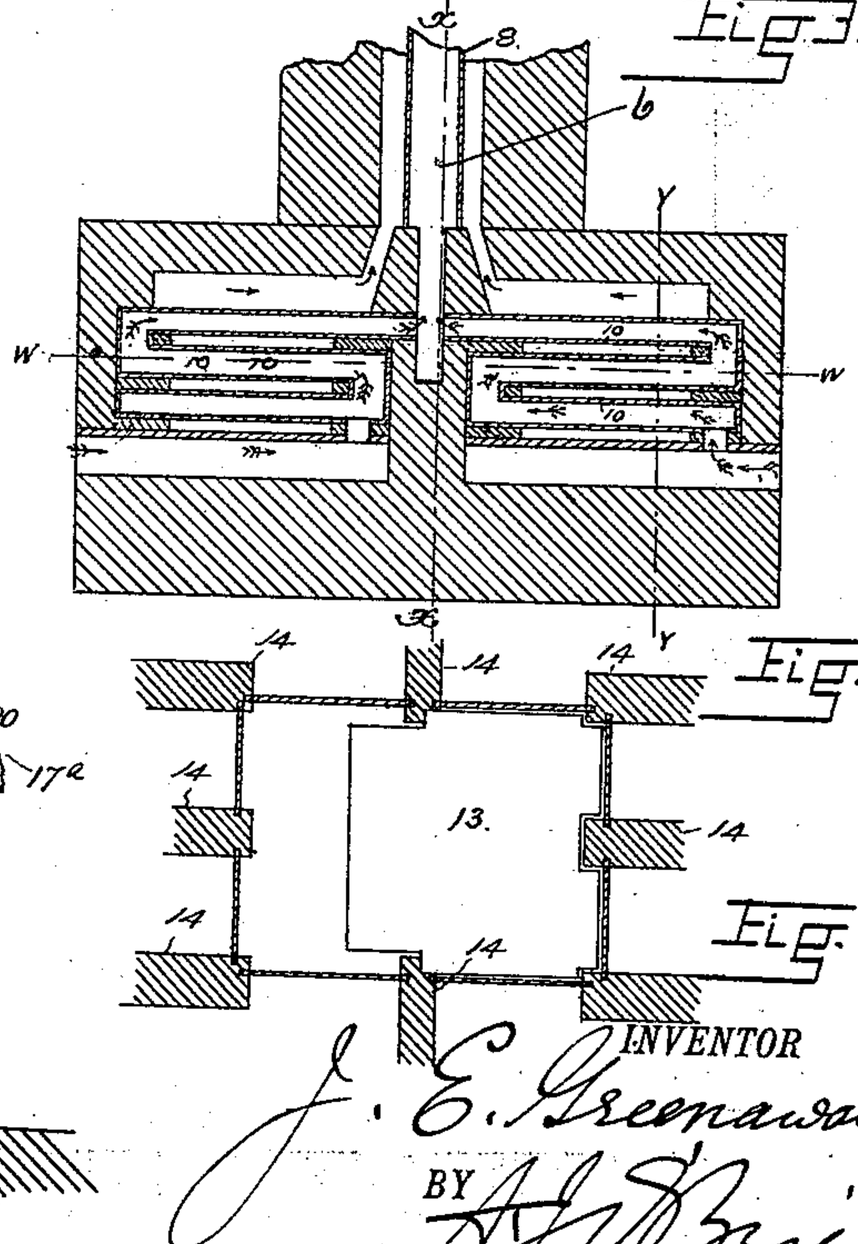

Fig. 2.

Fig. 6.

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UNITED STATES PATENT OFFICE.

JOHN ECKERT GREENAWALT, OF DENVER, COLORADO, ASSIGNOR OF ONE-HALF TO WILLIAM ROBINSON, OF SAME PLACE.

OXIDIZING-FURNACE.

SPECIFICATION forming part of Letters Patent No. 551,725, dated December 17, 1895.

Application filed April 9, 1894. Renewed March 19, 1895. Serial No. 542,417. (No model.)

To all whom it may concern:

Be it known that I, JOHN ECKERT GREENAWALT, a citizen of the United States of America, residing at Denver, in the county of Arapahoe and State of Colorado, have invented certain new and useful Improvements in Oxidizing-Furnaces; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

My invention relates to improvements in oxidizing-furnaces.

The object of this invention is the economical preparatory treatment of refractory ores by the thorough and perfect oxidization of all objectionable elements, whereby all the gold is freed from its intimate mechanical and chemical combinations, disassociated from other metals or impurities, and left in a porous, malleable and clean condition, thus insuring successful amalgamation when the gold is brought in contact with the mercury.

When a refractory gold ore is oxidized in furnaces of such construction that the fuel gases are allowed to come in contact with the ore, the gold, although liberated, will not amalgamate readily, owing to the fact that the reducing gases of the furnace change some of the elements to the metallic state, in which condition they are readily absorbed or combined by or with the gold, forming an alloy which prevents the amalgamation of the gold except by long and continuous grinding in contact with mercury, and for the further reason that the gold becomes coated with a film of carbonaceous matter or metallic oxides, which prevents the gold from uniting with the mercury.

Most gold ores carry some objectionable elements, such as sulphur, arsenic, antimony, lead or zinc. These compounds, in the presence of the reducing gases and carbonaceous matter from the furnace, are frequently reduced, thus liberating the objectionable elements which form an alloy with the gold, producing a compound which amalgamates with the greatest difficulty. This is especially true of the ores containing arsenic and antimony, since the presence of either of these metals in the proportion of one part in a thousand will render the gold so brittle that it is incapable of being absorbed or attacked by the mercury. Therefore, in the preparation of ore for amalgamation, it is very essential to the successful extraction of gold to prevent the ore from coming in contact with the fuel gases. This I accomplish in my improved furnace by keeping the ore under treatment in a chamber entirely distinct from that occupied by the fuel gases. The film of oxide is entirely broken up and the gold completely released from any mechanical casing or covering by dropping the treated ore into an upward spray of water, which disintegrates the entire mass and reduces it to a fine powder.

In my improved furnace the necessary heat in the muffle-compartment to carry out the process of oxidization is obtained from three sources—namely, that transmitted through the wall of the muffle-chamber from the combustion-gases which proceed from the fireplace, that introduced by the superheated air, and that produced by the oxidization of the combustible elements of the ore, especially sulphur.

In the case of ores carrying a large percentage of sulphur, very little extraneous heat is necessary in carrying out the oxidizing process.

In the oxidization of ores containing zinc the loss by volatilization is almost eliminated, owing to the fact that the zinc is not transformed to the metallic condition, and therefore not volatilized, since the oxide of zinc is not volatile.

My improved oxidizing muffle and gold-cleansing furnace will be fully understood by reference to the accompanying drawings, in which is illustrated an embodiment thereof.

In the drawings, Figure 1 is a vertical longitudinal section taken on the line $x\,x$, Fig. 2. Fig. 2 is a section taken on the line $n\,n$, Fig. 1. Fig. 3 is a horizontal section taken on the line $w\,w$, Fig. 2. Fig. 4 is a vertical section taken on the line $y\,y$, Fig. 2. Fig. 5 is a horizontal section taken on the line $v\,v$, Fig. 1. Fig. 6 is a horizontal section taken through the muffle-compartment and the sur-

rounding flues, the construction being shown on a larger scale.

Similar reference characters indicate corresponding parts or elements in all the views.

Referring now to the views, the furnace consists essentially of a tower 5 containing a vertical muffle-compartment 6 surrounded by vertical flues 7 for heating the exterior surface of the muffle-wall 8, and a suitable combustion-chamber 9 containing a series of flues 10 for heating the air necessary for the oxidization of the objectionable elements contained in the ore.

The muffle-compartment 6 contains a series of inclined shelves or slabs 13 alternately arranged one above another on opposite sides of the wall 8, and so placed that one discharges its ore upon the next lower shelf on the opposite side of the chamber, and so on. Hence, the pulverized ore carried upward by a suitable elevator 12 and discharged in a thin stream into the top of the muffle compartment or chamber 6 engages and rolls over each plate or shelf in succession in its downward course.

The inclined shelves 13 are supported by vertical columns 14, which form vertical partitions separating the space around the wall of the muffle-chamber into the separate vertical flues 7 and projecting slightly into the muffle-compartment for the purpose stated. This manner of supporting the shelves is shown in Fig. 6.

The wall 8 inclosing the muffle-chamber containing this series of shelves is composed of thin slabs of some mineral substance, as fire-clay, capable of withstanding a high degree of heat, and which will not be attacked by the corroding gases of the furnace. Thus, the ore in its descent, is completely isolated from the fuel gases, and never comes in contact with them during its treatment, whereby the oxidized product is free from these deleterious influences. The thin wall 8 is preferably supported by the columns 14 hereinbefore mentioned in connection with the shelves 13, which they support, thus relieving the wall 8 of the strain incident to said support.

The fuel gases pass upward through the vertical flues 7 and on the outside of the thin wall 8, through which the heat from the combustion-chamber is readily conveyed to the interior of the wall, or into the muffle-compartment.

The ore, in its downward course, meets the highly-heated air containing oxygen in a pure and highly-active condition, thus producing in the glowing-chamber an intensely-oxidizing atmosphere, through which it is almost impossible for any particle of ore to pass without being perfectly oxidized. This heated air is introduced into the lower end of the muffle compartment or chamber, its course from the outside through the furnace being indicated by the feathered arrows. This heated air enters the chamber 6 immediately after having passed through the incandescent flues of the combustion-chambers, and without having come in contact with any carbonaceous product or gases.

The descending ore particles gradually enter a purer and higher heated atmosphere of oxygen, whereby they are continually losing their refractory character until the culminating point of the process is attained, when the ore meets a large volume of highly-heated air and loses its last objectionable elements. The ore has now been thoroughly oxidized and freed from its natural impurities, while the gold has been liberated from the mechanical and chemical combinations without the production of detrimental alloys. The oxidized ore then passes from the chamber 6 through the inclined flue 15 at the bottom, and thence into the chamber 17 containing an upward spray of cold water issuing from a nozzle 18 connected with any suitable water-forcing apparatus. In this spraying-chamber the ore particles are thoroughly disintegrated, while all films of oxides covering the gold are removed.

The chamber 17 is provided at its upper extremity or mouth 17ª with a fan 20, which is typical of any suitable suction-inducing mechanism, whose function is to remove the steam or vapor generated by the engagement of the hot ore with the cold spray of water.

The unfeathered arrows indicate the course of the heat from the combustion-chamber to the flues 7 surrounding the oxidizing-chamber.

The feathered arrows indicate the course of the air-currents passing into the oxidizing-chamber 6.

I claim—

1. In an ore roasting furnace, the combination with the combustion chamber, of a vertical oxidizing chamber separated from the combustion chamber, an outer chamber surrounding the oxidizing chamber and divided by vertical columns into flues connected with the combustion chamber, and air flues located in the combustion chamber and leading to the oxidizing chamber, substantially as described.

2. In a stack oxidizing furnace, the combination with the combustion chamber, of a muffle-compartment separated from the combustion chamber and containing inclined shelves arranged one above another and supported on the wall inclosing the compartment, whereby the ore is made to fall from one shelf to another, air flues located in the combustion chamber and opening into the bottom of the muffle-compartment, an outer chamber surrounding the muffle-compartment and divided by vertical columns into flues connected with the combustion chamber, whereby said flues receive the fuel gases from said chamber, substantially as described.

3. In an oxidizing furnace, a muffle-compartment or chamber having the inclined

shelves arranged therein and adapted to feed from one to another, an inclined discharge flue leading from the bottom of the muffle-chamber to another chamber, said last named chamber being provided with means for throwing an upward spray of water to meet the falling ore, an auxiliary flue or conduit 17 located outside of the furnace and connected with the spray chamber, and suitable suction inducing mechanism connected with said conduit for drawing off the steam generated by the contact of the hot ore with the water, which steam is thus prevented from passing to the muffle-compartment, substantially as described.

4. In an ore roasting furnace, the combination with the combustion chamber, of a vertical oxidizing chamber separated from the combustion chamber, and an outer chamber surrounding the oxidizing chamber and divided by vertical columns into flues which are connected with the combustion chamber, substantially as described.

In testimony whereof I affix my signature in the presence of two witnesses.

JOHN ECKERT GREENAWALT.

Witnesses:
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CHAS. E. DAWSON.